

Amendments to the Claims:

The listing of claims below will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (currently amended): ~~Apparatus~~ An apparatus comprising a first ~~thin photosensitive~~ photosensitive sol-gel derived thin film (~~including an organometallic photosensitizer~~) on a substrate ~~containing oxygen and silicon~~, said sol-gel film including at least first and second spaced apart regions which include SiO₂ with a ~~high~~ comparatively higher index of refraction channel therebetween, wherein said channel including comprises a metal oxide doped silica region of Si - O - M - O - Si where M is a metal, said metal oxide is photodeposited from an organometallic photosensitizer, and said channel including includes different indices of refraction along the axis thereof.

Claim 2 (currently amended): ~~Apparatus~~ The apparatus as in claim 1 wherein said substrate comprises glass.

Claim 3 (currently amended): ~~Apparatus~~ The apparatus as in claim 1 wherein said substrate comprises silicon, said substrate including a surface layer of silicon dioxide.

Claim 4 (currently amended): ~~Apparatus~~ The apparatus as in claim 1 wherein ~~said first channel includes Si - O - M - O - Si said channel having a relatively high index of refraction compared to that of adjacent regions of said film~~, said channel including includes at least a portion comprising

alternating regions of different concentrations of photodeposited metal oxide, and thereby indices of refraction, Si - O - M - O - Si and SiO₂ for defining a grating.

Claim 5 (currently amended): ~~Apparatus~~ The apparatus as in claim 4 wherein ~~said regions of SiO₂ have different dimensions~~ the period of the grating varies along the axis of said channel.

Claim 6 (currently amended): ~~Apparatus~~ An apparatus comprising a substrate having a silica surface layer, said apparatus including a thin sol-gel glass film thereon, said thin sol-gel film including therein at least a first metal oxide waveguide channel having a ~~relatively~~ comparatively high refractive index as compared to surrounding portions of said thin sol-gel film, wherein said metal oxide is photodeposited.

Claim 7 (currently amended): ~~Apparatus~~ The apparatus as in claim 6 also including first and second electrodes formed astride said metal oxide waveguide channel, and wherein said channel exhibits with electro-optic properties ~~channel~~ and is responsive to a voltage impressed thereon by said electrodes to vary the index of refraction locally therein.

Claim 8 (currently amended): ~~Apparatus~~ The apparatus as in claim 7 including wherein said sold-gel film includes a plurality of metal oxide waveguide channels each comprising metal oxide doped silica regions of Si - O - M - O - Si where M is a metal taken from a class consisting of ~~groups IVA and IVB, Group VI, Groups IVA, IVB, VIB, and~~ transition metals and rare earth metals from the periodic table, and the index of refraction in said channels ~~varying differently~~ is different in each.

Claim 9 (currently amended): ~~Apparatus~~ The apparatus as in claim 6 wherein said substrate comprises a glass.

Claim 10 (currently amended): ~~Apparatus~~ The apparatus as in claim 6 wherein said substrate comprises silicon having a surface layer of silicon dioxide.

Claim 11 (currently amended): ~~Apparatus~~ An apparatus comprising a substrate having a silica surface layer, said apparatus including a thin sol-gel glass film thereon, said sol-gel film including therein at least first and second photodeposited metal oxide [[[waveguide]]] waveguide channels, said channels being in close proximity only in a first region thereof, and said apparatus including signal-responsive means for switching light signals from said first to said second channel controllably.

Claim 12 (withdrawn): A method for forming a high refractive index metal oxide waveguide channel in a sol-gel derived glass, said method comprising the steps of forming a photosensitive sol-gel film including an organometallic photosensitizer on a silica substrate said method comprising the steps of exposing said film through a mask to light of a wavelength and for a time for unbinding different amounts of metal constituents and of said sensitizer in different sections along at least a first channel thereof, exposing said film to heat at a first temperature and for a time to drive off the unbound sensitizer and to bind the metal constituents of said sol-gel film, and exposing said layer to heat at a second temperature higher than said first temperature for a time to unbind and drive off the organic constituents of said sol-gel film.

Claim 13 (withdrawn): A method as in claim 12 wherein the step of exposing said layer to ultraviolet light is carried out through a photo mask for confining said light to a first channel of said film, and for defining second and third unexposed regions to first and second sides of said channel, said unexposed regions defining first and second interfaces with said first channel respectively.

Claim 14 (withdrawn): A method as in claim 13 wherein said step of exposing said layer to ultra violet light through a photo mask defines a plurality of spaced - apart first channels, each of said first regions having first and second interfaces with second and third unexposed regions respectively, said channels having differently varying indices of refraction therealong.

Claim 15 (currently amended): ~~Apparatus~~ An apparatus comprising a substrate having a silicon dioxide surface, said apparatus including a photosensitive sol-gel derived glass film thereon, said film including at least a first channel therein having an index of refraction sufficiently higher therein than the index of refraction in adjacent regions to confine ~~therein~~ light introduced at an input thereof, said channel having a continuous variation in index of refraction therealong.

Claim 16 (currently amended): ~~Apparatus~~ The apparatus as in claim 15 including a first plurality of said channels organized along closely spaced paths between said input and an output, each of said channels ~~having~~ including a continuously-varying index of refraction different from that of any other one of said ~~[[channels..]]~~ channels.

Claim 17 (currently amended): ~~Apparatus~~ The apparatus as in claim 16 wherein each of said channels is configured to transmit light of a different wavelength.

Claim 18 (currently amended): ~~Apparatus~~ The apparatus as in claim 1 wherein the index of refraction in said channel changes in a manner to define spaced apart Bragg gratings for reflecting light therebetween.

Claim 19 (canceled)

Claim 20 (currently amended): ~~Apparatus~~ The apparatus as in claim 1 ~~also further~~ including first and second electrodes ~~connected adjacent~~ to said channel at first and second interfaces ~~with said adjacent regions to first and second sides thereof of said first and second spaced apart regions.~~

Claim 21 (currently amended): ~~Apparatus~~ The apparatus as in claim 16 comprising a plurality of photosensitive sol-gel derived glass films, at least two of said films each ~~said apparatus~~ including [[n pluralities]] a plurality of said channels arranged ~~in each of said film each of said n pluralities~~ extending to extend between an input and an output.

Claim 22 (currently amended): ~~Apparatus~~ The apparatus as in claim 20 also including means for impressing a voltage between said first and second electrodes.

Claim 23 (currently amended): ~~Apparatus~~ The apparatus as in claim 1 wherein a portion of said channel comprises a photodeposited magnetic material, said apparatus also including means for generating a magnetic field in at least said portion of said channel.

Claim 24 (currently amended): ~~Apparatus~~ The apparatus as in claim 22 wherein said electrodes are ~~connected adjacent~~ to a first portion of said channel and said channel divides into first and second derivative channels at said portion.

Claim 25 (currently amended): ~~Apparatus~~ The apparatus as in claim 23 wherein said means for generating is ~~coupled adjacent~~ to a first portion of said channel and said channel divides into first and second derivative channels at said portion.

Claim 26 (currently amended): ~~Apparatus~~ The apparatus as in claim 1 having a plurality of ~~high index of refraction~~ said channels therein extending from a common input to a common output, each

of said channels having a different radius of curvature for providing a low loss transmission path for a different wavelength therein.

Claim 27 (currently amended): ~~Apparatus~~ The apparatus as in claim 26 also including fiber optic means for introducing at said input light having a band of wavelengths including each of said different wavelengths.

Claim 28 (currently amended): ~~Apparatus~~ The apparatus as in claim 27 wherein said film includes means for dividing said band of wavelengths into a set of individual wavelengths, one for each of said channels.

Claim 29 (currently amended): ~~Apparatus~~ The apparatus as in claim 27 including at least a second sol-gel film on said first sol-gel film, said second sol-gel film also including a plurality of ~~high index of refraction~~ said channels therein extending from a common input to a common output, each of said channels in said second film having a different radius of curvature for providing a low loss transmission path for a different wavelength therein.

Claim 30 (currently amended): ~~Apparatus~~ The apparatus as in claim 28 having first and second optical fibers coupled to the common inputs of said first and second film respectively for introducing input light having a band of wavelengths including each of said different wavelengths.

Claim 31 (withdrawn): A method for forming a multilayered sol-gel film device, said method comprising the steps of 1) forming a first sol-gel film including components R - M - X on a substrate containing SiO₂, 2) exposing the film to light through a mask for unbinding X and binding M, 3) heating the film at a first temperature and for a time to drive off X and permanently bind M to SiO₂,

4) heating the film at a second higher temperature to drive off R and M from unexposed regions of the film, 5) forming a second sol-gel film and said first sol-gel film and repeating steps 2), 3), and 4).

Claim 32 (withdrawn): A method for forming an integrated optic chip including a plurality of high index of refraction channels having a longitudinal axis extending from an input to an output end, said method comprising the steps of forming an photosensitive sol-gel film including an organometallic photosensitizer on the surface of a substrate having a surface composed of silicon dioxide, exposing said sol-gel film through a gray scale mask to radiation of a wavelength and for a time to bind differing amounts of metal constituents of said sol-gel film to said silicon oxide and to unbind said photosensitizer, said mask having different regions of opacity for each of said channels for producing in said channels differing concentrations of said metal constituents therein, heating said sol-gel film at a first temperature and for a time to drive off said sensitizer and bind said different amounts of said metal constituents to the silicon dioxide in said channels permanently, and heating said sol-gel film at a second relatively higher temperature for unbinding the organic constituents of said sol-gel film and for driving off the organic constituents.

Claim 33 (new): An integrated optic device having a spatially varying refractive index profile comprising:

- (a) a substrate;
- (b) a photosensitive sol-gel derived thin film on a substrate, said sol-gel film including a spatially varied refractive index profile and being formed by a process comprising: i.) forming a photosensitive sol-gel film on a substrate, ii.) exposing the photosensitive sol-gel film through a gray scale mask to light, wherein the gray scale mask includes a gray scale image corresponding to the integrated optic device, and iii.) heat treating the exposed sol-gel film.

Claim 34 (new): An integrated optic device comprising:

- (a) a substrate; and
- (b) a photosensitive sol-gel derived film layer disposed on said substrate, said sol-gel film comprising an embedded waveguide channel having different concentrations of photodeposited metal oxide along the axis of said channel thereby resulting in different photoinduced indices of refraction along the axis of said channel.

Claim 35 (new): An integrated optic device according to claim 34 wherein said sol-gel derived film layer comprises a silica based glass.

Claim 36 (new): An integrated optic device according to claim 34 wherein said substrate comprises glass.

Claim 37 (new): An integrated optic device according to claim 34 wherein said substrate comprises silicon and includes a surface layer of silicon dioxide.

Claim 38 (new): An integrated optic device according to claim 34 wherein the different photoinduced indices of refraction along the axis of said channel define a grating.

Claim 39 (new): An integrated optic device according to claim 34 wherein the different photoinduced indices of refraction along the axis of said channel comprise a continuous variation in the index of refraction along the axis of said channel.

Claim 40 (new): An integrated optic device comprising:

- (a) a substrate; and

(b) a photosensitive sol-gel derived film layer disposed on said substrate, said sol-gel film comprising a plurality of embedded waveguide channels each having a different photoinduced refractive index profile along its axis.

Claim 41 (new): An integrated optic device according to claim 40, wherein said sol-gel film further comprises a glass, and wherein each waveguide channel comprises a different concentration of photodeposited metal oxide than that of the other waveguides in said plurality.

Claim 42 (new): An integrated optic device according to claim 40 wherein said glass is a silica based glass.

Claim 43 (new): An integrated optic device according to claim 40 wherein said substrate comprises glass.

Claim 44 (new): An integrated optic device according to claim 40 wherein said substrate comprises silicon and includes a surface layer of silicon dioxide.

Claim 45 (new): An integrated optic device according to claim 40 wherein said plurality of channels define a waveguide array.

Claim 46 (new): An integrated optic device according to claim 40 wherein each of the refractive index profiles for said plurality of channels comprises a variation in the index of refraction along the axis of said channels.